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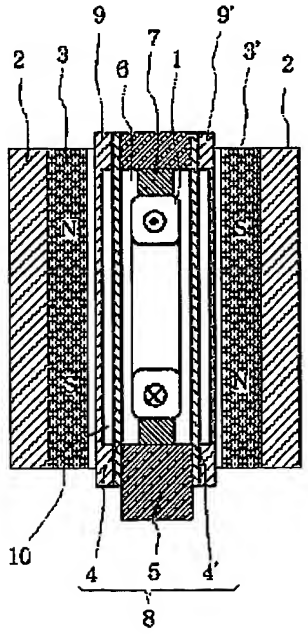
(54)【発明の名称】　リニアモータ並びにこれを有するステージ装置および露光装置

(57)【要約】
【課題】　リニアモータコイル表面の保護膜にダメージを与えることなく、コイルを効率良く冷却し、このリニアモータを用いた装置の性能向上を図る。
【解決手段】　コイルと該コイルを覆い内部空間に冷媒が供給されるジャケットを有するリニアモータにおいて、該ジャケットを内側ジャケットと外側ジャケットからなる二重ジャケット構造とし、コイルの内側ジャケットと外側ジャケットに性質の異なる二種類の冷媒を流す。



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【特許請求の範囲】

【請求項１】　コイルと該コイルを覆い内部空間に冷媒が供給されるジャケットを有するリニアモータにおいて．該ジャケットを内側ジャケットと外側ジャケットとからなる二重ジャケット構造とし、コイルの内側ジャケットと外側ジャケットに性質の異なる二種類の冷媒を流すことを特徴とするリニアモータ。

【請求項２】　前記内側ジャケットに供給する冷媒が不活性冷媒であることを特徴とする請求項１記載のリニアモータ。

【請求項３】　前記二重ジャケットは．前記コイルを固定するためのフレームと該フレームを挟んで該リニアモータの駆動方向に対し両側面に各々二枚のシートを重ねて接合して形成されたものである請求項１または２記載のリニアモータ。

【請求項４】　前記二重ジャケットは．非磁性体材料であって電気的高抵抗材または絶縁体材料からなることを特徴とする請求項１～３のいずれかに記載のリニアモータ。

【請求項５】　前記二重ジャケットを挟んで前記コイルに対向する磁石が取り付けられたヨークが設けられていることを特徴とする請求項１～４のいずれかに記載のリニアモータ。

【請求項６】　請求項１～５のいずれかに記載のリニアモータを駆動機構として有することを特徴とするステージ装置。

【請求項７】　請求項６記載のステージ装置で基板を搭載し該基板に露光を行う手段を有することを特徴とする露光装置。

【請求項８】　請求項７記載の露光装置を用いてデバイスを製造することを特徴とするデバイス製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は．例えば半導体露光装置や高精度加工機など精密な位置決めを行うための装置などに好適に使用されるリニアモータに関するものである。

【０００２】

【従来の技術】半導体露光装置や高精度加工機などで使用されるナノメートルオーダーの位置決め装置では、駆動源であるリニアモータからの発熱が位置決めに悪影響を及ぼす。発熱による構造体の熱変形あるいは空気温度の上昇による位置計測のレーザ干渉計の計測誤差などの要因によって．リニアモータの搭載された装置の位置決め精度が悪化する。例えば．１℃の温度変化であっても１００ｍｍの低熱膨張材（熱膨張係数１×１０$^{-6}$）は１００ｎｍだけ変形するし．また、光干渉式測長計の光路における空気温度の変化が１℃以下であっても測定値に１００ｎｍの誤差が生じ得る。従って．これらの温度変化の防止策としてリニアモータの冷却．特にリニアモータから発生する熱の回収が必要となっている。

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【０００３】一方、装置の高性能化に伴い、リニアモータの高出力化が要求されており、そのためにコイルに流れる電流を増やすと発熱量も大きく増大する。よってさらなる冷却能力の増強が必要とされる。また、コイル温度の上昇によるコイル抵抗の増加やコイル線の破損を防ぐためにも、コイルの冷却能力を高めることは重要である。

【０００４】図４は冷却手段を備えた従来のリニアモータの構成を示す図である。同図のリニアモータは．コイル１とその両側のヨーク２に固定された永久磁石３、３'により構成され、コイル１は肉薄のシート４．４'およびフレーム５で構成されたジャケット８で覆われている。コイル１は固定具７によってフレーム５に固定されている。ここでジャケット８の内部空間６に冷媒を流すことにより．コイルからの発生熱を回収している。

【０００５】

【発明が解決しようとする課題】上記従来例において、冷媒の流量を一定にしてコイルの冷却能力を上げるためには．冷媒に熱の吸収効率の高いものを使うと有効であるが．反面冷媒は高圧電流の流れているコイルに直接に接しているため．活性化した冷媒であると、コイル表面の保護膜が破損し電気的な絶縁破壊が起こりリニアモータの機能を失う恐れがある。これを防ぐため化学的に不活性な冷媒をコイル冷却に用いているが、一般的に不活性冷媒は熱の吸収効率が悪く、リニアモータの出力をさらに上げるために大電力を流すと、冷却能力が不足する可能性があった。

【０００６】本発明は、上記課題を解決するためのもので．リニアモータコイル表面の保護膜にダメージを与えることなくコイルからの発熱を効率良く除去することで位置決め精度に及ぼす影響．構造体の熱変形、レーザ干渉計の計測誤差等をなくし．このリニアモータを使用した優れたステージ装置や露光装置、デバイス製造方法などを提供することを目的とする。

【０００７】

【問題を解決するための手段】上記目的を達成するため．本発明では．コイルと該コイルを覆い内部空間に冷媒が供給されるジャケットを有するリニアモータにおいて．該ジャケットを内側と外側との二重構造とし．コイルの内側ジャケットと外側ジャケットに性質の異なる二種類の冷媒を流すことを特徴とする。このような二重ジャケットは、例えばコイルと該コイルを覆い内部空間に冷媒が供給されるジャケットを有する従来のリニアモータに対し、該ジャケットの外側に冷媒が供給される外側ジャケットを付加することにより得られる。内側ジャケットには、コイル表面の保護膜を破損させないよう不活性冷媒を流す。外側ジャケットには．活性、不活性にかかわらず冷却効率の良い冷媒を流す。

【０００８】本発明のステージ装置は．上記構成のリニ

アモータを駆動機構として有することを特徴とするものであり、本発明の露光装置は上記ステージ装置で基板を搭載して、該基板に露光を行う手段を有することを特徴とするものである。また本発明のデバイス製造方法は上記露光装置を用いてデバイスを製造することを特徴とするものである。

【０００９】

【作用】本発明によれば、コイル内側ジャケットに不活性冷媒を使用して、コイル表面の絶縁層にダメージを与えることを防止している。また、コイル内側ジャケットに一般的に冷却能力の劣る不活性冷媒を使用したことによる冷却能力の不足を、二重ジャケットの外側ジャケットに冷却効率の良い冷媒を流すことにより、補うことができる。よって、本発明によれば、コイル表面の絶縁層にダメージを与えることなくリニアモータコイルからの発熱を吸収し、精度に及ぼす影響、構造体の熱変形、レーザ干渉計の計測誤差等をなくし、このリニアモータを使用した優れたステージ装置や露光装置、デバイス製造方法などを提供することができる。

【００１０】

【実施例】（実施例１）図１は本発明の一実施例に係る単相リニアモータの構成を表す図である。図２は図１のリニアモータの内部構造を説明する分解図、図３は図１のリニアモータの斜視図である。

【００１１】図１において、１は駆動用の電流が流れるコイル、２は磁気回路を構成する２つのヨーク、３は各ヨーク２に固定され異なる磁気同士が互いに対向して配置された永久磁石である。４、４′はコイル１を挟んで配されたシート、５は２枚のシート４、４′同士を支持するフレームであり、該シート４、４′とフレーム５によって、コイル１を内包する内側ジャケットを構成している。６は該内側ジャケットの内部空間であり、７はコイル１をフレーム５に固定している固定具である。９、９′は本実施例の特徴部材である二重ジャケットの外側ジャケットを構成する部材であり、１０は該外側ジャケットの内部空間である。シート４、４′および９、９′とフレーム５との接合は接着剤やボルトなどで固定されている。シート４、４′、フレーム５、シート９、９′の材質は非磁性体材料であり、また電気的高抵抗材または絶縁体材料、例えば高分子樹脂材料またはセラミックス材料が好ましい。

【００１２】図２および図３において、２０はコイル１のリード線（２本）、２１はリード線２０をジャケット内部から外部へ引出すための小孔である。この小孔２１から冷媒が漏れ出さないように、リード線を引き出した後に接着剤等で小孔が気密に封止されている。２２および２３は内側ジャケットに接続された冷媒の供給管および回収管である。冷媒は供給管２２から供給されて内側ジャケット内を流れコイルの発生熱を受け取り、回収管２３から回収される。コイル１の導線自体が直接冷媒に触れないようコイル表面には保護膜が形成されているが、保護膜にダメージを与えないために、冷媒は液体または気体であっても不活性冷媒を供給する。２４および２５は外側ジャケットに接続された冷媒の供給管および回収管である。冷媒は供給管２４から供給されて外側ジャケット内を流れ、内側ジャケットを流れている冷媒から、シート４、４′を介してコイルの発熱を受け取り、回収管２５から回収される。外側ジャケットに供給する冷媒は、液体または気体であってもよい。また不活性冷媒である必要はないが、熱の吸収効率の高いものが好ましい。

【００１３】上記構成において、固定磁界を発生している永久磁石３、３′の間の空間に位置するコイル１に電流を流すとローレンツ力が働き、コイル１と永久磁石３、３′は図１の紙面内上下方向に相対的に運動する。例えば、同図の上側半分においては、磁界は紙面の左から右方向へ、電流が紙面の奥から手前方向に流れると、電流の大きさに応じた力がコイル１には紙面の上方向へ永久磁石３、３′には下方向へ働き、それぞれが相対的に移動する。このようにコイルに所定の電流を流すことにより、ヨーク（すなわち永久磁石３、３′）およびコイルがそれぞれ固定されている構造物を駆動するものである。なお、本実施例ではコイル１がフレーム５に固定されており、コイル側が固定子、永久磁石が保持されたヨーク側が可動子となったいわゆるムービングマグネット型のリニアモータとなっているが、固定子と可動子が逆であってもよい。また、図１ではコイル１は固定具７によってフレーム５に固定しているが、シート４、４′に固定するようにしてもよい。

【００１４】（実施例２）図５は実施例１で説明したリニアモータを用いたウエハステージを有する露光装置の一例を示す。同図において、５１はあおり機構を有するウエハステージ天板（あおりステージ）であり、上面に半導体ウエハ５３を搭載している。あおりステージ５１の上方には、光源や照明光学系を有する照明系５７、ウエハに転写すべきパターンを備えたレチクル５８、該レチクル５８のパターンを所定の倍率で縮小投影する縮小投影光学系５９が設けられている。

【００１５】ウエハステージの構成について説明する。５４はあおりステージ５１を水平方向のみ規制するガイドであり、例えば静圧軸受を用いることによって、２方向、傾斜方向および２軸回転方向の運動を許容している。５６はベースである。５５は上記説明した実施例１の構成を備えたリニアモータであり、３個のリニアモータ（残りの１個は図示せず）の駆動によって、ステージ５１の重力方向である２方向の位置あるいは傾きをベース５６に対して調節することができる。また、ステージ５１の２方向の位置および傾きを計測することにより、ウエハステージとしての２方向の位置および傾きを制御できる。

【００１６】本実施例によれば、リニアモータの冷却効率が上がり、コイルから発生する熱のほぼ全量を回収しているので、リニアモータ２５ａ、２５ｂからの発熱がステージ５１に伝わって温度上昇させたり、雰囲気温度を上昇させることがないため、ウエハステージの位置決め精度を飛躍的に向上させることができ、ひいては従来以上に高精度な露光転写が可能となる。

【００１７】（実施例３）図６は上記露光装置を使用した半導体デバイス（ＩＣやＬＳＩ等の半導体チップ、あるいは液晶パネルやＣＣＤ等）の生産フローを示す。ステップ１（回路設計）では半導体デバイスの回路設計を行う。ステップ２（マスク製作）では設計した回路パターンを形成したマスクを製作する。ステップ３（ウエハ製造）ではシリコン等の材料を用いてウエハを製造する。ステップ４（ウエハプロセス）は前工程と呼ばれ、上記用意したマスクとウエハを用いて、リソグラフィ技術によってウエハ上に実際の回路を形成する。ステップ５（組み立て）は後工程と呼ばれ、ステップ４によって作製されたウエハを用いて半導体チップ化する工程であり、アッセンブリ工程（ダイシング、ボンディング）、パッケージング工程（チップ封入）等の工程を含む。ステップ６（検査）ではステップ５で作製された半導体デバイスの動作確認テスト、耐久性テスト等の検査を行う。こうした工程を経て半導体デバイスが完成し、これが出荷（ステップ７）される。

【００１８】図７は上記ウエハプロセスの詳細なフローを示す。ステップ１１（酸化）ではウエハの表面を酸化させる。ステップ１２（ＣＶＤ）ではウエハ表面に絶縁膜を形成する。ステップ１３（電極形成）ではウエハに電極を蒸着によって形成する。ステップ１４（イオン打込み）ではウエハにイオンを打ち込む。ステップ１５（レジスト処理）ではウエハに感光剤を塗布する。ステップ１６（露光）では上記説明した露光装置によってマスク回路パターンをウエハに焼付露光する。ステップ１７（現像）では露光したウエハを現像する。ステップ１８（エッチング）では現像したレジスト像以外の部分を削り取る。ステップ１９（レジスト剥離）ではエッチングが済んで不要となったレジストを取り除く。これらのステップを繰り返し行うことによって、ウエハ上に多重に回路パターンが形成される。

【００１９】

【発明の効果】本発明によれば、コイルのジャケットを二重ジャケット構造にしてコイル内側ジャケットに不活性冷媒を流すことでコイル表面の保護膜にダメージを与えることなく一次冷却を行い、一般的に熱の吸収効率の悪い不活性冷媒を流した一次冷却で完全に除去できなかった熱を外側ジャケットで二次冷却することにより、総合的に冷却効率を上げることができるようになった。その結果コイルに、より大電力を流すことが可能となり、リニアモータの推力向上によるステージ装置の高速化が実現できた。またコイルからの発熱を少なくすることができたので、ステージ装置の熱による構造体の熱変形、レーザー干渉計の計測誤差を少なくすることができステージ装置の精度向上ができた。

【図面の簡単な説明】

【図１】　本発明の実施例１に係るリニアモータを説明する上面図である。

【図２】　図１のリニアモータのジャケット構成を示す分解図である。

【図３】　図１のリニアモータの外観を表す斜視図である。

【図４】　従来例のリニアモータを説明する上面図である。

【図５】　本発明の実施例２に係るステージを有する露光装置の構成図である。

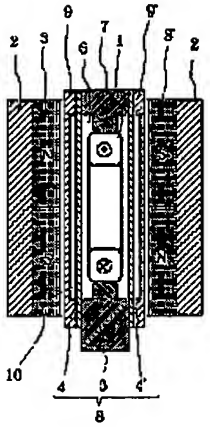
【図６】　本発明の実施例３に係る半導体デバイスの製造フローを示す図である。

【図７】　図６のウエハプロセスの詳細なフローを示す図である。

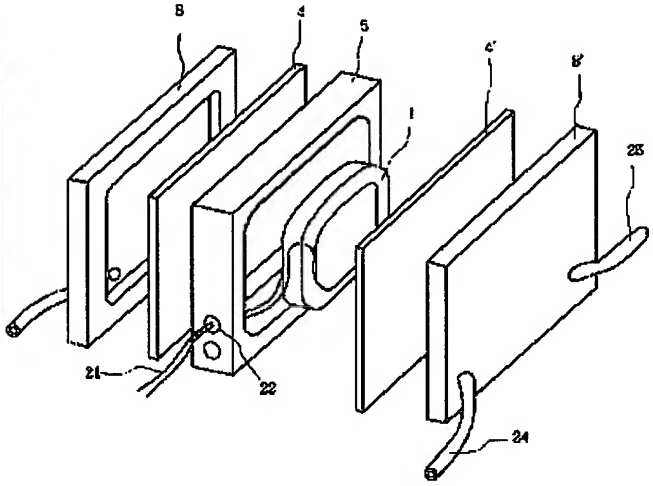
【符号の説明】

１：コイル、２：ヨーク、３、３’：永久磁石、４、４’：内側ジャケットシート、５：フレーム、７：固定具、９、９’：外側ジャケットシート。

【図１】



【図２】



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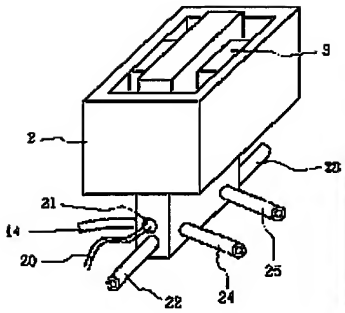

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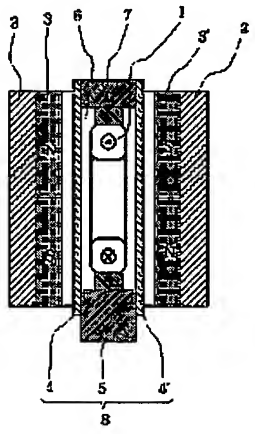

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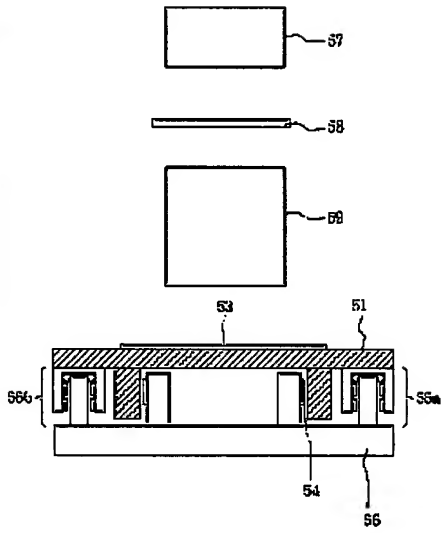

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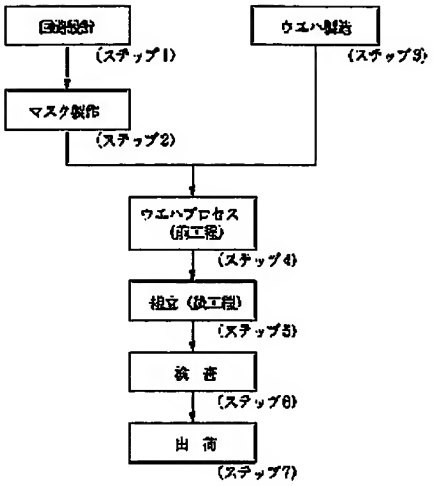
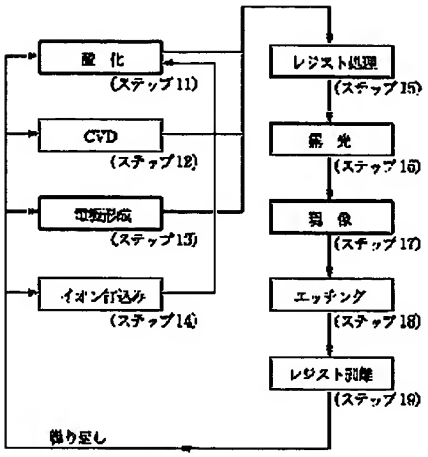


半導体デバイス製造フロー

【図７】



ウエハプロセス

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Begin Translation:

CLAIMS

[Claim(s)]
[Claim 1] The linear motor which makes this jacket the double jacket structure which consists of an inside jacket and an outer jacket in the linear motor which has the jacket with which a coil and this coil are covered and a refrigerant is supplied to a building envelope, and is characterized by pouring two kinds of refrigerants with which properties differ in the inside jacket and outer jacket of a coil.
[Claim 2] The linear motor according to claim 1 characterized by the refrigerant supplied to the aforementioned inside jacket being an inactive refrigerant.
[Claim 3] The aforementioned double jacket is a linear motor according to claim 1 or 2 which joins the sheet of two sheets to a both-sides side in piles respectively, and is formed in it to the driving direction of this linear motor on both sides of the frame and this frame for fixing the aforementioned coil.
[Claim 4] The aforementioned double jacket is a linear motor according to claim 1 to 3 which is non-magnetic-material material and is characterized by the bird clapper from electric high resistance material or insulator material.
[Claim 5] The linear motor according to claim 1 to 4 characterized by preparing the yoke with which the magnet which counters the aforementioned coil on both sides of the aforementioned double jacket was attached.
[Claim 6] Stage equipment characterized by having a linear motor according to claim 1 to 5 as a drive.
[Claim 7] The aligner characterized by having a means to carry a substrate with stage equipment according to claim 6, and to expose to this substrate.
[Claim 8] The device manufacture method characterized by manufacturing a device using an aligner according to claim 7.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the linear motor used suitable for the equipment for performing precise positioning, such as for example, a semiconductor aligner and a high precision finishing machine, etc.
[0002]

[Description of the Prior Art] In the pointing device of the nano meter order used by the semiconductor aligner, the high precision finishing machine, etc., generation of heat from the linear motor which is a driving source has a bad influence on positioning. According to factors, such as a measurement error of the laser interferometer of the position measurement by heat deformation of the structure by generation of heat, or elevation of air temperature, the positioning accuracy of the equipment with which the linear motor was carried gets worse. For example, even if it is a 1-degree C temperature change, 100mm low-fever expansion material (coefficient of thermal expansion 1x10-6) transforms only 100nm, and even if change of the air temperature in the optical path of an optical interference formula length measurement meter is 1 degree C or less, a 100nm error may arise in measured value. Therefore, cooling of a linear motor, especially recovery of the heat generated from a linear motor are needed as a preventive measure of these temperature changes.

[0003] On the other hand, with highly-efficient-izing of equipment, the high increase in power of a linear motor is demanded, and if the current which flows in a coil for the reason is increased, calorific value will also increase greatly. Therefore, reinforcement of the further refrigeration capacity is needed. Moreover, in order to prevent the increase in coil resistance and the breakage of a coil line by elevation of coil temperature, it is important to heighten the refrigeration capacity of a coil.

[0004] Drawing 4 is drawing showing the composition of the conventional linear motor equipped with the cooling means. The linear motor of this drawing is constituted by the permanent magnet 3 and 3' which were fixed to the coil 1 and the yoke 2 of the both sides, and the coil 1 is covered in the jacket 8 which consisted of a sheet 4 of closing in, 4', and a frame 5. The coil 1 is being fixed to the frame 5 by the fastener 7. The generating heat from a coil is collected by pouring a refrigerant to the building envelope 6 of a jacket 8 here.

[0005]

[Problem(s) to be Solved by the Invention] There is a possibility of the protective coat on the front face of a coil being damaged as it is the activated refrigerant since the opposite side refrigerant is directly in contact with the coil with which high tension current is flowing, and electric dielectric breakdown happening although it is effective if the high thing of the absorption efficiency of heat is used for a refrigerant in order to fix the flow rate of a refrigerant and to improve the refrigeration capacity of a coil in the above-mentioned conventional example, and losing the function of a linear motor. Although the inactive refrigerant was chemically used for coil cooling in order to prevent this, in order that the absorption efficiency of heat might be bad and might raise the output of a linear motor further, when large power was passed, generally refrigeration capacity may have been insufficient for the inactive refrigerant.

[0006] this invention is for solving the above-mentioned technical problem, abolishes the influence which exerts generation of heat from a coil on positioning accuracy by removing efficiently, heat deformation of the structure, the measurement error of a laser interferometer, etc., without giving a damage to the protective coat of a linear motor coil front face, and aims at offering outstanding stage equipment and the outstanding aligner which used this linear motor, the device manufacture method, etc.

[0007]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, in this invention, in the linear motor which has the jacket with which a coil and this coil are covered and a refrigerant is supplied to a building envelope, this jacket is made into the dual structure of the inside and an outside, and it is characterized by pouring two kinds of refrigerants with which properties differ in the inside jacket and outer jacket of a coil. Such a double jacket is obtained by adding the outer jacket by which a refrigerant is supplied to

the outside of this jacket to the conventional linear motor which has the jacket with which a coil and this coil are covered and a refrigerant is supplied to a building envelope. In an inside jacket, an inactive refrigerant is poured so that the protective coat on the front face of a coil may not be damaged. In an outer jacket, a refrigerant with sufficient cooling efficiency is poured irrespective of activity and inactive.

[0008] The stage equipment of this invention is characterized by having the linear motor of the above-mentioned composition as a drive, and it is characterized by for the aligner of this invention carrying a substrate with the above-mentioned stage equipment, and having a means to expose to this substrate. Moreover, the device manufacture method of this invention is characterized by manufacturing a device using the above-mentioned aligner.

[0009]

[Function] According to this invention, it has prevented using an inactive refrigerant for a coil inside jacket, and giving a damage to the insulating layer on the front face of a coil. Moreover, shortage of the refrigeration capacity by having used the inactive refrigerant in which refrigeration capacity is generally inferior in a coil inside jacket is suppliable by pouring a refrigerant with sufficient cooling efficiency to the outer jacket of a double jacket. Therefore, according to this invention, generation of heat from a linear motor coil can be absorbed without giving a damage to the insulating layer on the front face of a coil, the influence affect precision, heat deformation of the structure, the measurement error of a laser interferometer, etc. can be abolished, and outstanding stage equipment and the outstanding aligner which used this linear motor, the device manufacture method, etc. can be offered.

[0010]

[Example] (Example 1) Drawing 1 is drawing showing the composition of the single phase linear motor concerning one example of this invention. The exploded view and drawing 3 drawing 2 explains the internal structure of the linear motor of drawing 1 to be are the perspective diagram of the linear motor of drawing 1 .

[0011] In drawing 1 , the coil with which the current for a drive in 1 flows, two yokes with which 2 constitutes a magnetic circuit, and 3 are permanent magnets with which MAG which are fixed to each yoke 2 and are different countered mutually, and they have been arranged. The sheet with which 4 and 4' was allotted on both sides of the coil 1, and 5 are the sheet 4 of two sheets, and a frame which supports 4', and the inside jacket which connotes a coil 1 by this sheet 4, and 4' and a frame 5 is constituted. 6 is the building envelope of this inside jacket, and 7 is a fastener which is fixing the coil 1 to a frame 5. 9 and 9' -- the feature of this example -- it is the member which constitutes the outer jacket of the double jacket which is a member, and 10 is the building envelope of this outer jacket Junction on sheet 4, 4' and 9, and 9' and a frame 5 is being fixed with adhesives, the bolt, etc. a sheet -- four -- four -- ' -- a frame -- five -- a sheet -- nine -- nine -- ' -- the quality of the material -- non-magnetic-material material -- it is -- moreover, electric high resistance material, insulator material, for example, macromolecule resin material, or ceramic material -- being desirable .

[0012] In drawing 2 and drawing 3 , it is a stoma for 20 pulling out lead wire 20 to the lead wire (2) of a coil 1, and 21 pulling it out from the interior of a jacket to the exterior. After pulling out lead wire so that a refrigerant may not begin to leak from this stoma 21, the stoma is airtightly closed with adhesives etc. 22 and 23 are the supply pipes and recovery pipes of a refrigerant which were connected to the inside jacket. A refrigerant is supplied from a supply pipe 22, flows the inside of an inside jacket, receives the generating heat of a coil, and are collected from the recovery pipe 23. Although the protective coat is formed in the coil front face so that the lead wire of a coil 1 itself cannot touch a direct refrigerant, in order not to give a damage to a protective coat, even if a refrigerant is a liquid or a gas, it

supplies an inactive refrigerant. 24 and 25 are the supply pipes and recovery pipes of a refrigerant which were connected to the outer jacket. A refrigerant receives generation of heat of a coil from the refrigerant which is supplied from a supply pipe 24, flows the inside of an outer jacket, and is flowing the inside jacket through a sheet 4 and 4', and are collected from the recovery pipe 25. The refrigerant supplied to an outer jacket may be a liquid or a gas. Moreover, although it is not necessary to be an inactive refrigerant, the high thing of the absorption efficiency of heat is desirable.

[0013] In the above-mentioned composition, if current is passed in the permanent magnet 3 which has generated the fixed field system, and the coil 1 located in the space between 3', a Lorentz force will work and a coil 1, a permanent magnet 3, and 3' will exercise relatively [direction / vertical / of drawing 1 / in space]. For example, in the top half of this drawing, if current flows in the direction of this side from the back of space rightward from the left of space, the force according to the size of current will work a magnetic field to above [of space] in a coil 1, and it works downward to a permanent magnet 3 and 3', and each moves relatively. Thus, by passing predetermined current in a coil, the structure with which the yoke (namely, a permanent magnet 3, 3') and the coil are being fixed, respectively is driven. In addition, a stator and a needle may be reverse, although the coil 1 is being fixed to the frame 5 and the coil side serves as a so-called MUBINGU magnet type linear motor from which the yoke side with which the stator and the permanent magnet were held became a needle in this example. Moreover, although it is fixing to a frame 5 by the fastener 7, you may make it fix a coil 1 to a sheet 4 and 4' in drawing 1 .

[0014] (Example 2) Drawing 5 shows an example of the aligner which has a wafer stage using the linear motor explained in the example 1. In this drawing, 51 is a wafer stage top plate (gate stage) which has a gate mechanism, and carries the semiconductor wafer 53 in the upper surface. The reduction projection optical system 59 which carries out reduction projection of the pattern of the illumination system 57 which has the light source and lighting optical system above the gate stage 51, the reticle 58 equipped with the pattern which should be imprinted to a wafer, and this reticle 58 for a predetermined scale factor is formed.

[0015] The composition of a wafer stage is explained. 54 is a guide which carries out horizontal chisel regulation of the gate stage 51, for example, permits movement of a Z direction, the inclination direction, and zeta shaft hand of cut by using a hydrostatic bearing. 56 is the base. 55 is the linear motor equipped with the composition of an example 1 which gave [above-mentioned] explanation, and can adjust the position or inclination of the direction of zeta which is the gravity direction of a stage 51 to the base 56 by the drive of three linear motors (the one remaining pieces are not shown). Moreover, the position and inclination of the direction of zeta as a wafer stage are controllable by measuring the position and inclination of the direction of zeta of a stage 51.

[0016] According to this example, since the whole quantity is collected mostly and there is nothing of the heat which the cooling efficiency of a linear motor goes up and is generated from a coil for which generation of heat from linear motors 25a and 25b gets across to a stage 51, and carries out a temperature rise, or raises ambient temperature, the positioning accuracy of a wafer stage can be raised by leaps and bounds, as a result a highly precise exposure imprint than before is attained.

[0017] (Example 3) Drawing 6 shows the production flow of the semiconductor devices (semiconductor chips, such as IC and LSI, or a liquid crystal panel, CCD, etc.) which used the above-mentioned aligner. The circuit design of a semiconductor device is performed at Step 1 (circuit design). The mask in which the designed circuit pattern was formed is manufactured at Step 2 (mask manufacture). At Step 3 (wafer manufacture), a wafer is manufactured using material, such as silicon. Step 4 (wafer process) is called last process,

and forms an actual circuit on a wafer with lithography technology using the mask and wafer which carried out [above-mentioned] preparation. Step 5 (assembly) is called back process, is a process semiconductor-chip-ized using the wafer produced by Step 4, and includes processes, such as an assembly process (dicing, bonding) and a packaging process (chip enclosure). At Step 6 (inspection), the check test of the semiconductor device produced at Step 5 of operation, an endurance test, etc. are inspected. A semiconductor device is completed through such a process and this is shipped (Step 7).

[0018] Drawing 7 shows the detailed flow of the above-mentioned wafer process. The front face of a wafer is oxidized at Step 11 (oxidization). An insulator layer is formed in a wafer front face at Step 12 (CVO). At Step 13 (electrode formation), an electrode is formed in a wafer by vacuum evaporationo. Ion is driven into a wafer at Step 14 (ion implantation). A sensitization agent is applied to a wafer at Step 15 (resist processing). At Step 16 (exposure), printing exposure of the mask circuit pattern is carried out by the aligner which gave [above-mentioned] explanation at a wafer. The exposed wafer is developed at Step 17 (development). At Step 18 (etching), portions other than the developed resist image are shaved off. The resist which etching could be managed with Step 19 (resist ablation), and became unnecessary is removed. By carrying out by repeating these steps, a circuit pattern is formed on a wafer multiplex.

[0019]

[Effect of the Invention] Cooling efficiency can be synthetically gathered now by performing the primary cooling of concrete, without giving a damage to the protective coat on the front face of a coil by making the jacket of a coil into double jacket structure, and pouring an inactive refrigerant in a coil inside jacket according to this invention, and carrying out the secondary cooling of concrete of the heat which has not been completely removed by the primary cooling of concrete which generally poured the bad inactive refrigerant of the absorption efficiency of heat by the outer jacket. As a result, it became possible to pass large power more in a coil, and improvement in the speed of the stage equipment by the improvement in a thrust of a linear motor has been realized. Moreover, since generation of heat from a coil was lessened, heat deformation of the structure by the heat of stage equipment and the measurement error of a laser interferometer could be lessened, and improvement in precision of stage equipment was completed.

TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the linear motor used suitable for the equipment for performing precise positioning, such as for example, a semiconductor aligner and a high precision finishing machine, etc.

PRIOR ART

[Description of the Prior Art] In the pointing device of the nano meter order used by the semiconductor aligner, the high precision finishing machine, etc., generation of heat from the linear motor which is a driving source has a bad influence on positioning. According to factors, such as a measurement error of the laser interferometer of the position measurement by heat deformation of the structure by generation of heat, or elevation of air temperature, the positioning accuracy of the equipment with which the linear motor was carried gets worse. For example, even if it is a 1-degree C temperature change, 100mm low-fever expansion material (coefficient of thermal expansion 1x10-6) transforms only 100nm, and even if change of the air temperature in the optical path of an optical interference formula length measurement meter is 1 degree C or less, a 100nm error may

arise in measured value. Therefore, cooling of a linear motor, especially recovery of the heat generated from a linear motor are needed as a preventive measure of these temperature changes.

[0003] On the other hand, with highly-efficient-izing of equipment, the high increase in power of a linear motor is demanded, and if the current which flows in a coil for the reason is increased, calorific value will also increase greatly. Therefore, reinforcement of the further refrigeration capacity is needed. Moreover, in order to prevent the increase in coil resistance and the breakage of a coil line by elevation of coil temperature, it is important to heighten the refrigeration capacity of a coil.

[0004] Drawing 4 is drawing showing the composition of the conventional linear motor equipped with the cooling means. The linear motor of this drawing is constituted by the permanent magnet 3 and 3' which were fixed to the coil 1 and the yoke 2 of the both sides, and the coil 1 is covered in the jacket 8 which consisted of a sheet 4 of closing in, 4', and a frame 5. The coil 1 is being fixed to the frame 5 by the fastener 7. The generating heat from a coil is collected by pouring a refrigerant to the building envelope 6 of a jacket 8 here.

EFFECT OF THE INVENTION

[Effect of the Invention] Cooling efficiency can be synthetically gathered now by performing the primary cooling of concrete, without giving a damage to the protective coat on the front face of a coil by making the jacket of a coil into double jacket structure, and pouring an inactive refrigerant in a coil inside jacket according to this invention, and carrying out the secondary cooling of concrete of the heat which has not been completely removed by the primary cooling of concrete which generally poured the bad inactive refrigerant of the absorption efficiency of heat by the outer jacket. As a result, it became possible to pass large power more in a coil, and improvement in the speed of the stage equipment by the improvement in a thrust of a linear motor has been realized. Moreover, since generation of heat from a coil was lessened, heat deformation of the structure by the heat of stage equipment and the measurement error of a laser interferometer could be lessened, and improvement in precision of stage equipment was completed.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] There is a possibility of the protective coat on the front face of a coil being damaged as it is the activated refrigerant since the opposite side refrigerant is directly in contact with the coil with which high-voltage current is flowing, and electric dielectric breakdown happening although it is effective if the high thing of the absorption efficiency of heat is used for a refrigerant in order to fix the flow rate of a refrigerant and to improve the refrigeration capacity of a coil in the above-mentioned conventional example, and losing the function of a linear motor. Although the inactive refrigerant was chemically used for coil cooling in order to prevent this, in order that the absorption efficiency of heat might be bad and might raise the output of a linear motor further, when large power was passed, generally refrigeration capacity may have been insufficient for the inactive refrigerant.

[0006] this invention is for solving the above-mentioned technical problem, abolishes the influence which exerts generation of heat from a coil on positioning accuracy by removing efficiently, heat deformation of the structure, the measurement error of a laser interferometer, etc., without giving a damage to the protective coat of a linear motor coil front face, and aims at offering outstanding stage equipment and the outstanding aligner which used this linear motor, the device manufacture method, etc.

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, in this invention, in the linear motor which has the jacket with which a coil and this coil are covered and a refrigerant is supplied to a building envelope, this jacket is made into the dual structure of the inside and an outside, and it is characterized by pouring two kinds of refrigerants with which properties differ in the inside jacket and outer jacket of a coil. Such a double jacket is obtained by adding the outer jacket by which a refrigerant is supplied to the outside of this jacket to the conventional linear motor which has the jacket with which a coil and this coil are covered and a refrigerant is supplied to a building envelope. In an inside jacket, an inactive refrigerant is poured so that the protective coat on the front face of a coil may not be damaged. In an outer jacket, a refrigerant with sufficient cooling efficiency is poured irrespective of activity and inactive.
[0008] The stage equipment of this invention is characterized by having the linear motor of the above-mentioned composition as a drive, and it is characterized by for the aligner of this invention carrying a substrate with the above-mentioned stage equipment, and having a means to expose to this substrate. Moreover, the device manufacture method of this invention is characterized by manufacturing a device using the above-mentioned aligner.

OPERATION

[Function] According to this invention, it has prevented using an inactive refrigerant for a coil inside jacket, and giving a damage to the insulating layer on the front face of a coil. Moreover, shortage of the refrigeration capacity by having used the inactive refrigerant in which refrigeration capacity is generally inferior in a coil inside jacket is suppliable by pouring a refrigerant with sufficient cooling efficiency to the outer jacket of a double jacket. Therefore, according to this invention, generation of heat from a linear motor coil can be absorbed without giving a damage to the insulating layer on the front face of a coil, the influence affect precision, heat deformation of the structure, the measurement error of a laser interferometer, etc. can be abolished, and outstanding stage equipment and the outstanding aligner which used this linear motor, the device manufacture method, etc. can be offered.

EXAMPLE

[Example] (Example 1) Drawing 1 is drawing showing the composition of the single phase linear motor concerning one example of this invention. The exploded view and drawing 3 drawing 2 explains the internal structure of the linear motor of drawing 1 to be are the perspective diagram of the linear motor of drawing 1 .
[0011] In drawing 1 , the coil with which the current for a drive in 1 flows, two yokes with which 2 constitutes a magnetic circuit, and 3 are permanent magnets with which MAG which are fixed to each yoke 2 and are different countered mutually, and they have been arranged. The sheet with which 4 and 4' was allotted on both sides of the coil 1, and 5 are the sheet 4 of two sheets, and a frame which supports 4', and the inside jacket which connotes a coil 1 by this sheet 4, and 4' and a frame 5 is constituted. 6 is the building envelope of this inside jacket, and 7 is a fastener which is fixing the coil 1 to a frame 5. 9 and 9' -- the feature of this example -- it is the member which constitutes the outer jacket of the double jacket which is a member, and 10 is the building envelope of this outer jacket Junction on sheet 4, 4' and 9, and 9' and a frame 5 is being fixed with adhesives, the bolt, etc. a sheet -- four -- four -- ' -- a frame -- five -- a sheet -- nine -- nine -- ' -- the quality of

the material -- non-magnetic-material material -- it is -- moreover, electric high resistance material, insulator material, for example, macromolecule resin material, or ceramic material -- being desirable .

[0012] In drawing 2 and drawing 3 , it is a stoma for 20 pulling out lead wire 20 to the lead wire (2) of a coil 1, and 21 pulling it out from the interior of a jacket to the exterior. After pulling out lead wire so that a refrigerant may not begin to leak from this stoma 21, the stoma is airtightly closed with adhesives etc. 22 and 23 are the supply pipes and recovery pipes of a refrigerant which were connected to the inside jacket. A refrigerant is supplied from a supply pipe 22, flows the inside of an inside jacket, receives the generating heat of a coil, and are collected from the recovery pipe 23. Although the protective coat is formed in the coil front face so that the lead wire of a coil 1 itself cannot touch a direct refrigerant, in order not to give a damage to a protective coat, even if a refrigerant is a liquid or a gas, it supplies an inactive refrigerant. 24 and 25 are the supply pipes and recovery pipes of a refrigerant which were connected to the outer jacket. A refrigerant receives generation of heat of a coil from the refrigerant which is supplied from a supply pipe 24, flows the inside of an outer jacket, and is flowing the inside jacket through a sheet 4 and 4', and are collected from the recovery pipe 25. The refrigerant supplied to an outer jacket may be a liquid or a gas. Moreover, although it is not necessary to be an inactive refrigerant, the high thing of the absorption efficiency of heat is desirable.

[0013] In the above-mentioned composition, if current is passed in the permanent magnet 3 which has generated the fixed field system, and the coil 1 located in the space between 3', a Lorentz force will work and a coil 1, a permanent magnet 3, and 3' will exercise relatively [direction / vertical / of drawing 1 / in space]. For example, in the top half of this drawing, if current flows in the direction of this side from the back of space rightward from the left of space, the force according to the size of current will work a magnetic field to above [of space] in a coil 1, and it works downward to a permanent magnet 3 and 3', and each moves relatively. Thus, by passing predetermined current in a coil, the structure with which the yoke (namely, a permanent magnet 3, 3') and the coil are being fixed, respectively is driven. In addition, a stator and a needle may be reverse, although the coil 1 is being fixed to the frame 5 and the coil side serves as a so-called MUBINGU magnet type linear motor from which the yoke side with which the stator and the permanent magnet were held became a needle in this example. Moreover, although it is fixing to a frame 5 by the fastener 7, you may make it fix a coil 1 to a sheet 4 and 4' in drawing 1 .

[0014] (Example 2) Drawing 5 shows an example of the aligner which has a wafer stage using the linear motor explained in the example 1. In this drawing, 51 is a wafer stage top plate (gate stage) which has a gate mechanism, and carries the semiconductor wafer 53 in the upper surface. The reduction projection optical system 59 which carries out reduction projection of the pattern of the illumination system 57 which has the light source and lighting optical system above the gate stage 51, the reticle 58 equipped with the pattern which should be imprinted to a wafer, and this reticle 58 for a predetermined scale factor is formed.

[0015] The composition of a wafer stage is explained. 54 is a guide which carries out horizontal chisel regulation of the gate stage 51, for example, permits movement of a Z direction, the inclination direction, and zeta shaft hand of cut by using a hydrostatic bearing. 56 is the base. 55 is the linear motor equipped with the composition of an example 1 which gave [above-mentioned] explanation, and can adjust the position or inclination of the direction of zeta which is the gravity direction of a stage 51 to the base 56 by the drive of three linear motors (the one remaining pieces are not shown). Moreover, the position and inclination of the direction of zeta as a wafer stage are controllable by measuring the position and inclination of the direction of zeta of a stage 51.

[0016] According to this example, since the whole quantity is collected mostly and there is nothing of the heat which the cooling efficiency of a linear motor goes up and is generated from a coil for which generation of heat from linear motors 25a and 25b gets across to a stage 51, and carries out a temperature rise, or raises ambient temperature, the positioning accuracy of a wafer stage can be raised by leaps and bounds, as a result a highly precise exposure imprint than before is attained.
[0017] (Example 3) Drawing 6 shows the production flow of the semiconductor devices (semiconductor chips, such as IC and LSI, or a liquid crystal panel, CCD, etc.) which used the above-mentioned aligner. The circuit design of a semiconductor device is performed at Step 1 (circuit design). The mask in which the designed circuit pattern was formed is manufactured at Step 2 (mask manufacture). At Step 3 (wafer manufacture), a wafer is manufactured using material, such as silicon. Step 4 (wafer process) is called last process, and forms an actual circuit on a wafer with lithography technology using the mask and wafer which carried out [above-mentioned] preparation. Step 5 (assembly) is called back process, is a process semiconductor-chip-ized using the wafer produced by Step 4, and includes processes, such as an assembly process (dicing, bonding) and a packaging process (chip enclosure). At Step 6 (inspection), the check test of the semiconductor device produced at Step 5 of operation, an endurance test, etc. are inspected. A semiconductor device is completed through such a process and this is shipped (Step 7).
[0018] Drawing 7 shows the detailed flow of the above-mentioned wafer process. The front face of a wafer is oxidized at Step 11 (oxidization). An insulator layer is formed in a wafer front face at Step 12 (CVO). At Step 13 (electrode formation), an electrode is formed in a wafer by vacuum evaporationo. Ion is driven into a wafer at Step 14 (ion implantation). A sensitization agent is applied to a wafer at Step 15 (resist processing). At Step 16 (exposure), printing exposure of the mask circuit pattern is carried out by the aligner which gave [above-mentioned] explanation at a wafer. The exposed wafer is developed at Step 17 (development). At Step 18 (etching), portions other than the developed resist image are shaved off. The resist which etching could be managed with Step 19 (resist ablation), and became unnecessary is removed. By carrying out by repeating these steps, a circuit pattern is formed on a wafer multiplex.

DESCRIPTION OF DRAWINGS

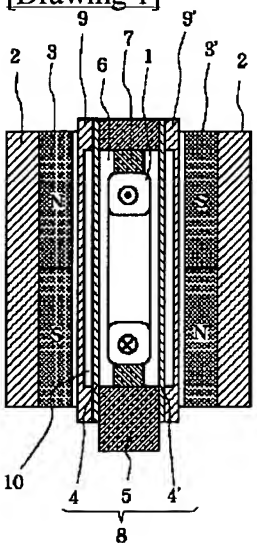
[Brief Description of the Drawings]
[Drawing 1] It is a plan explaining the linear motor concerning the example 1 of this invention.
[Drawing 2] It is the exploded view showing the jacket composition of the linear motor of drawing 1 .
[Drawing 3] It is a perspective diagram showing the appearance of the linear motor of drawing 1 .
[Drawing 4] It is a plan explaining the linear motor of the conventional example.
[Drawing 5] It is the block diagram of the aligner which has a stage concerning the example 2 of this invention.
[Drawing 6] It is drawing showing the manufacture flow of the semiconductor device concerning the example 3 of this invention.
[Drawing 7] It is drawing showing the detailed flow of the wafer process of drawing 6 .
[Description of Notations]
1: A :permanent magnet, and coil, 2:yoke, 3, and 3 '4, 4':inside jacket sheet, 5:frame, 7:fastener, 9, 9' : outer-jacket sheet.

* NOTICES *

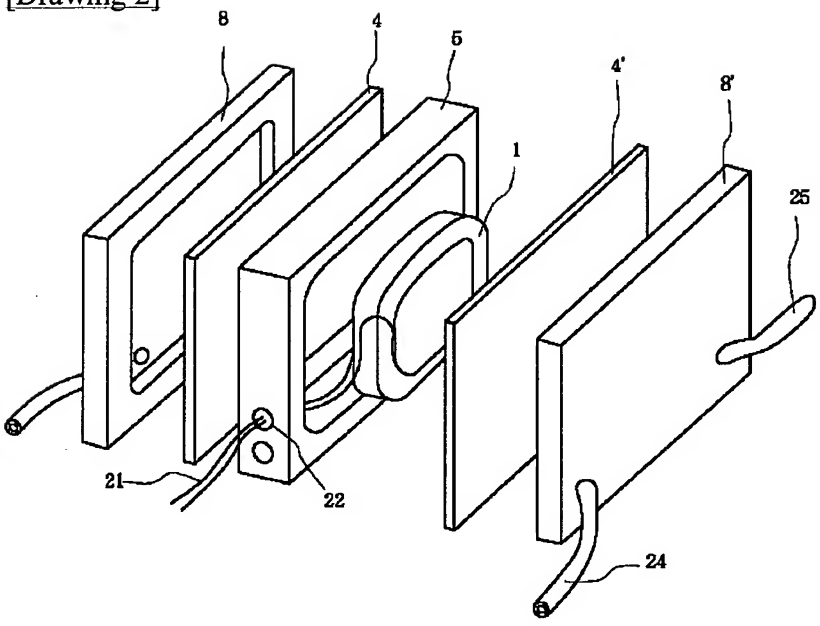
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

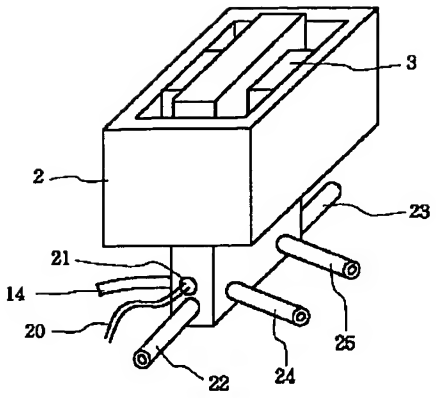
[Drawing 1]



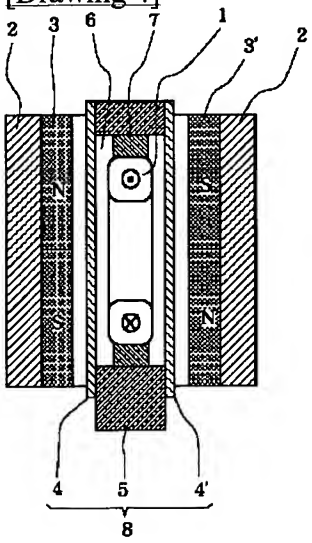
[Drawing 2]



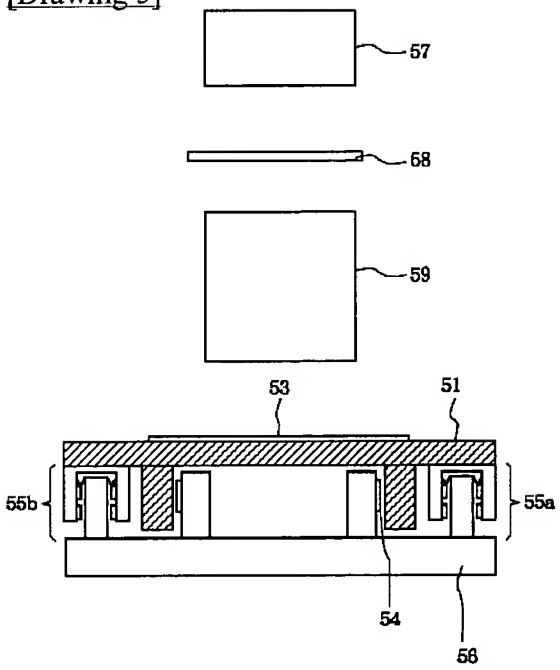
[Drawing 3]



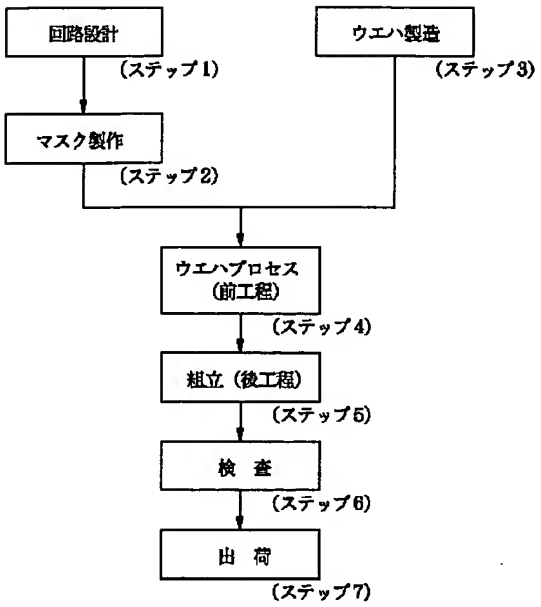
[Drawing 4]



[Drawing 5]

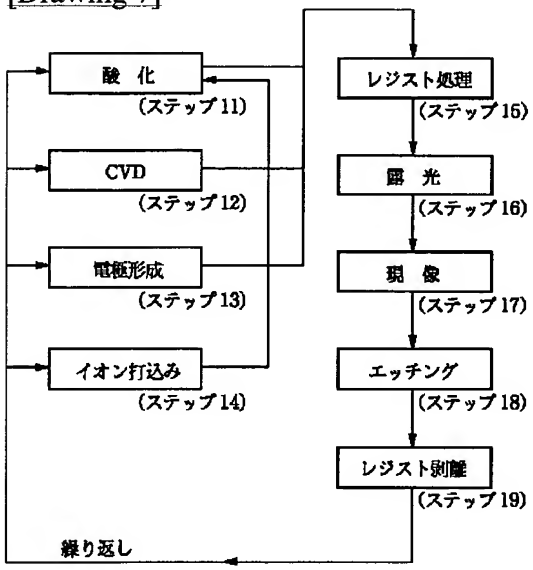


[Drawing 6]



半導体デバイス製造フロー

[Drawing 7]



ウエハプロセス

[Translation done.]